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DIALOG

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Chemical routes to improved mechanical properties of PECVD low k thin films.

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Abstract
Increasing the elastic modulus and **hardness** of low k films is one of the key challenges towards integration of these materials into future integrated circuits. Several approaches are explored for increasing the **hardness** of carbon doped oxide **(CDO)** dielectrics. Several low k precursors and their mixtures specifically chosen to enhance the **hardness** (H) and modulus (E) of **CDO** films through chemically induced cross-linking. Composition and FTIR measurements suggest the presence of C-C and C-Si cross-linking with concurrent observation of improved film **hardness** and modulus at relatively low deposition temperatures. Films deposited at 373°C using diethoxy-methyl-oxiranyl have a **hardness** and modulus of 2.5 **GPa** and 18.1 **GPa,** respectively. Films deposited at 180°C using tetramethylcyclotetrasiloxane (TMCTS) and 25% hardener have **hardness** and modulus of 1.5 **GPa** and 9.4 **GPa,** respectively. These film properties are significantly higher than those observed for TMCTS alone under similar deposition conditions. Based on these results a low temperature process with 25% hardener and 75% TMCTS combined with a porogen was used to produce a porous film with a k<2.5 and a **hardness** of 0.72 **GPa.**

Descriptors
DIELECTRIC-THIN-FILMS; ELASTIC-MODULI; FOURIER-TRANSFORM-SPECTRA; **HARDNESS;** INFRARED-SPECTRA; ORGANIC-COMPOUNDS; PERMITTIVITY; PLASMA-CVD; POROUS-MATERIALS.

Classification codes
A6860 Physical-properties-of-thin-films-nonelectronic*;
A8140J Elasticity-and-anelasticity;
A6220D Elasticity-elastic-constants;
A8140N Fatigue-embrittlement-and-fracture;
A6220M Fatigue-brittleness-fracture-and-cracks;
A7755 Dielectric-thin-films;
A7720 Dielectric-permittivity;
A7830G Infrared-and-Raman-spectra-in-inorganic-crystals;
A7865P Optical-properties-of-other-inorganic-semiconductors-and-insulators-thin-films-low-dimensional-structures;
A6825 Mechanical-and-acoustical-properties-of-solid-surfaces-and-interfaces;
A8115H Chemical-vapour-deposition;
A6855 Thin-film-growth-structure-and-epitaxy;
A5275R Plasma-applications-in-manufacturing-and-materials-processing;
B0520F Chemical-vapour-deposition*.

Keywords

chemical-method; elastic-modulus; **film**-hardness; PECVD-low-k-thin-films; mechanical-properties; integrated-circuits; carbon-doped-oxide-dielectrics; low-k-precursors; **CDO**-films; chemically-induced-cross-linking; composition-measurement; FTIR-measurement; C-C-cross-linking; C-Si-cross-linking; diethoxy-methyl-oxiranyl; tetramethylcyclotetrasiloxane; porous-film; porogen; film-properties; deposition-temperatures; 373-degC; 180-degC.

Treatment codes

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